Bangladesh J. Nuclear Agric, 37(1): 111-116, 2023 *ISSN 0258-7130*

DOI: https://doi.org/10.3329/bjnag.v37i1.69934 ***Short communication***

PROFITABILITY AND PRODUCTIVITY OF DROUGHT TOLERANT RICE VARIETY BINADHAN-21 IN SOME SELECTED AREAS OF BANGLADESH

R. Sultana, M.H. Rahman, M.R. Haque, M.M.A. Sarkar and S. Islam

Abstract

The study was conducted in five major BINA developed Aus rice growing areas of Bangladesh, namely Mymensingh, Rangpur, Kushtia, Chapai Nawabganj and Magura district. The study focused on the profitability and productivity of Binadhan-21; and the major constraints to Binadhan-21 production. Simple random sampling technique was followed for this study. A total of 100 farmers were randomly selected as sample size in the study areas, 20 from each district. Data were collected from Aus rice growers through interview schedule. Collected data were edited, summarized, tabulated and analyzed to fulfill the objectives. Some descriptive statistics were used. Binadhan-21 production is highly profitable in the study area. The average yield was 4.86 t ha^{-1} in Aus season and undiscounted BCR was 1.93. Therefore, Binadhan-21 farmers received high return on its investment. The farmers in the study areas encountered some constraints to Binadhan-21 production. The first ranked was unavailability of seeds in all areas. Other constraints were lack of training (70.83%), crop lost by bird and animal (56.61%), and natural calamities (19.30%).

Key words: Profitability, Binadhan-21, Drought tolerant, Constraints

Rice is a vital crop globally, accounting for over 21% of human caloric requirements and up to 76% of the calorific intake of Southeast Asian inhabitants (Zhao *et al.*, 2020). Rice, nutritious staple cereal, feeding more than half of the world's population is critically important for global food security (Islam *et al.*, 2020). Asia produces 90.6% of the global rice production, making it the world's largest producer (FAOSTAT, 2021, Bandumula, *et al.*, 2018). The region produces and consumes over 90 percent of the world's rice (Papademetriou, 2000; Zeigler, 2008). Rice is the most important crop in Bangladesh. Bangladesh has achieved major advances in agricultural development over the last 30 years, especially in rice production. Bangladesh is self-sufficient in rice (Mainuddin, *et al.*, 2050; Timsina, *et al.*, 2018) which is the staple food, with an average per capita consumption of 134 kg per annum, compared to the world average of 57 kg per annum (Mottaleb *et al.* 2016). Rice is the predominant crop in the three main crop-growing seasons in Bangladesh; Aus rice is grown during March to June, Aman rice during June/July to October/November and irrigated Boro rice during January to April/May (the Rabi season popularly known as Boro season). Total production of rice is increasing in Bangladesh in the year 2018-19 i.e. 363.91 lac MT from the year 2012-13 i.e. 338.33 lac MT (Fig. 1). Except Boro, Increasing trend of production was also seen for Aus and Aman seasons.

Agricultural Economics Division, Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh-2202
*Corresponding author's e-mail: razia1201@gmail.com

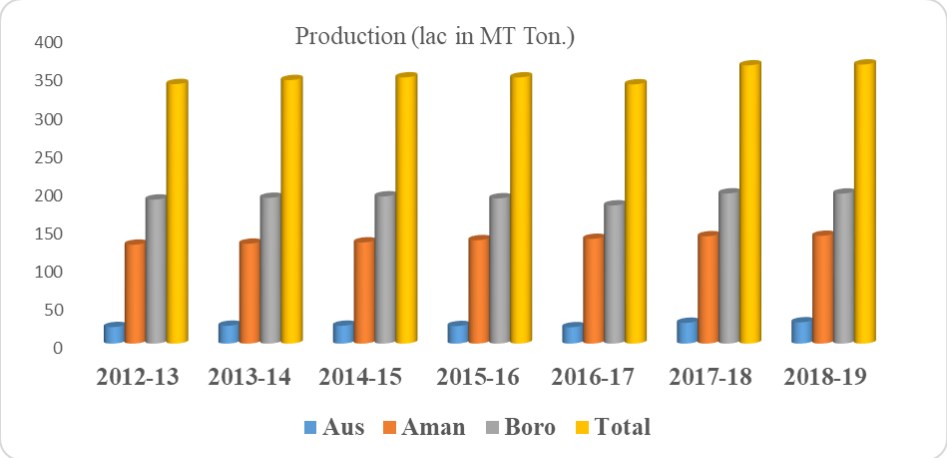

Fig. 1. Bar diagram showing rice production of 3 seasons in Bangladesh (Source: BBS, 2021)

Agriculture is a biological and societal activity, guided by several factors including climate. A large number of studies projected that climate change is likely adversely affected on crops production in the century in Bangladesh (Kabir *et al.,* 2017). Due to the continuing adverse effects of climate change, water deficit is expected to be a major challenge for sustained rice production in the near future (Wassmann, *et al.,* 2009). Besides, the population of Bangladesh will increase to 202 million by 2050 (Timsina *et al.,* 2018, UN, 2014). Therefore, the country needs to produce additional food grains by 2050 to meet the demand. The speculations regarding increase in frequency and intensity of droughts lays serious threat to sustained rice production and therefore to global food security (Mackill, *et al.,* 2010). Keeping this in mind, Bangladesh Institute of nuclear agriculture, (BINA) invented Binadhan-21 which is drought tolerant, Aus rice variety. The others traits of the varieties are: yield, in drought prone areas is 4.5 t ha^{-1}, height of mature tree is 94-98 cm, duration of lifespan is 100-105, the amount of amylose in rice is 24.9 percent. Therefore, the present study was undertaken to determine the profitability and productivity of the variety in field level and also to find out the constraints of the variety in cultivation.

A total of 100 farmers were randomly selected as sample size in the study areas, 20 from each district. Data were collected from Aus rice growers through interview schedule. Collected data were edited, summarized, tabulated and analyzed to fulfill the objectives. Some descriptive statistics were used for analyzing the collected data.

The following profit equation was employed to assess the profitability of Binadhan-21 production.

Net return/profit of producer

$$\pi = P_m Y_m + P_b Y_b - \sum (P_{x_i} X_i) - TFC$$

Where, π = Profit of producer per hectare

Pm = Per unit price of Binadhan-21 (Tk. kg^{-1})
Ym = Total quantity of Binadhan-21 (kg ha^{-1})
P_b = Price of by-product per unit
Y_b = Quantity of by-product
Px_i = Price of ith input per unit used for rice production
X_i = Quantity of the ith input used for rice production
TFC = Total fixed cost of Binadhan-21 producer

Cost of production

Variable cost: The cost of production included all kinds of variable costs such as hired labour, land preparation, seed, manure, fertilizers, irrigation, pesticides, etc. used for the production of rice. Both cash expenses and imputed value of family supplied inputs were included in the variable cost. The study revealed that in case of all farmers total variable cost of rice cultivation was Tk. 38857.37 ha^{-1} which was 58.45% of total cost of production (Table 1). It was the highest for large farmers 63.12% (41677.7 ha^{-1}) and the lowest for small farmers 55.95% (37503.99 ha^{-1}). The highest cost item was human labour which accounted for about 64.67 % of the total cost. Cost of land preparation and accounted for about 11% of total cost and ranked second cost item and then fertilizer cost was 9.31%.

Fixed cost: Family labour and rental value of land was considered as fixed cost of production. The family labour and land use cost were Tk. 27617.19 and Tk. 7877.19 ha^{-1} which was accounted for about 29.70% and 11.85% of total cost respectively (Table 1).

Table 1. Per hectare cost of Binadhan-21 production in different locations

Cost Component	Cost of production (Tk ha^{-1})							
	Small	% of total cost	Medium	% of total cost	Large	% of total cost	All	% of total cost
A) Variable Cost	37390.43	55.95	37503.99	56.34	41677.70	63.12	38857.37	58.45
Hired labour (Man days)	15206.58	22.75	15068.09	22.64	15848.15	24.00	15374.27	23.13
Power tiller	7580.92	11.34	7608.51	11.43	7851.85	11.89	7680.427	11.55
Seed	1914.47	2.87	1703.19	2.56	1711.11	2.59	1776.257	2.672
Fertilizers:								
Urea	1511.18	2.26	1532.55	2.30	1988.15	3.01	1677.293	2.52
TSP/DAP	2672.36	3.99	2521.48	3.79	2651.85	4.01	2615.23	3.93
MP	1505.26	2.25	1235.74	1.86	1163.7	1.76	1301.567	1.96
Sulphur	525.00	0.78	751.00	1.13	517	0.78	597.66	0.90
Gypsum	483.55	0.72	434.00	0.65	459.25	0.69	458.94	0.69
Cow dung	1710.53	2.56	1251.06	1.88	1333.33	2.02	1431.64	2.15
Insecticide	2262.95	3.38	2199.14	3.30	3988.52	6.04	2816.87	4.24
Irrigation	1546.05	2.31	2734.04	4.11	3666.67	5.55	2648.92	3.98
IOC	471.58	0.71	465.15	0.70	498.12	0.75	478.28	0.72
B) Fixed Cost	29438.48	44.05	29063.56	43.66	24349.54	36.88	27617.19	41.54
Family labour	22199.01	33.22	21152.93	31.78	15868.06	24.03	19740	29.70
Land use cost	7239.47	10.83	7910.63	11.88	8481.48	12.85	7877.193	11.85
Total Cost (A+B)	66828.91	100	66567.55	100	66027.24	100	66474.57	100

Source: Field Survey, 2020-21

Total cost: Total cost of production included variable costs and fixed costs incurred for Binadhan-21 cultivation. On an average, the total cost of production was Tk. 66474.57 ha^{-1} (Table 1).

Return from Binadhan-21

Per hectare average yield of Binadhan-21 was 4.86 ton and per kg average price was about Tk. 24.31. The average total return and gross margin of Binadhan-21 rice cultivation were found Tk. 128282.07 ha^{-1} and Tk. 89424.69 ha^{-1} respectively. Per hectare average net return was Tk. 61807.50 which was found to be highest in BCR on total cost basis was found 1.93 which was the highest for large farmer 2.13 and the lowest for small farmer 1.74. It was estimated that, to produce one kilogram of rice, total cost incurred Tk. 13.69 (Table 2).

Table 2. Profitability of Binadhan-21 in the study areas

Type	Farmer categories			
	Small	Medium	Large	All
Yield from Binadhan-21 (kg ha^{-1})	4742.89	4834.04	4994.07	4857.00
Price (Tk kg^{-1})	23.00	24.09	25.83	24.31
Return from Binadhan-21 (Tk. ha^{-1})	109086.47	116452.02	128996.83	118057.48
Return from straw (Tk. ha^{-1})	6907.89	11751.06	12014.81	10224.58
Gross return (Tk. ha^{-1})	115994.36	128203.08	141011.64	128282.07
Total variable cost (Tk. ha^{-1})	37390.43	37504.09	41677.70	38857.37
Total Cost (Tk. ha^{-1})	66828.91	66567.55	66027.24	66474.57
Gross margin (Tk. ha^{-1})	78603.93	90699.09	99333.94	89424.69
Net return (Tk. ha^{-1})	49165.45	61635.53	74984.40	61807.50
BCR on full cost	1.74	1.93	2.13	1.93
Cost of Production (Tk. kg^{-1})	14.09	13.77	13.22	13.69

Source: Field Survey, 2020-21

Major constraints to Binadhan-21 cultivation

Binadhan-21 is a profitable rice variety in the study areas. The farmers in the study areas encountered some constraints of Binadhan-21 production. The first ranked constraint was unavailability of Binadhan-21 varieties' seeds in all areas. Other constraints were lack of training (70.83%), crop lost by bird and animal (56.61%), and natural calamities (19.30%).

Table 3. Major constraints to Binadhan-21 cultivation in the study areas

Particulars	Categories (% of farmers responded)				Rank
	Small	Medium	Large	All	
Constraints					
Unavailability of seed	29.03	20.59	33.33	82.95	1
Lack of training	19.35	26.47	25.00	70.83	2
Natural calamities faces	08.65	06.65	4.00	19.30	4
Destroy by animal & bird	19.35	20.59	16.67	56.61	3

Binadhan-21 production is highly profitable in the study area. The average yield was 4.86 t ha^{-1} in Aus season and undiscounted BCR was 1.93. Therefore, Binadhan-21 farmers received high return on its investment. The farmers in the study areas encountered some constraints to Binadhan-21 production. The first ranked constraint was unavailability of Binadhan-21 varieties' seeds in all areas. Other constraints were lack of training (70.83%), destroy by bird and animal (56.61%), and natural calamities (19.30%).

References

Bandumula, N. 2018. Rice Production in Asia: Key to Global Food Security. Proc. Natl. Acad. Sci. India Sect. B Biol. Sci. 88: 1323–1328. [Google Scholar] [CrossRef]

FAOSTAT. 2021. Production/Yield Quantities of Rice, Paddy in World + (Total). Food and Agriculture Organization of the United Nations, Available online: https://www.fao.org/faostat/en/#data/QCL/visualize (accessed on 1 September 2021.

Islam, S.F., de Neergaard, A., Sander, B.O., Jensen, L.S., Wassmann, R. and van Groenigen, J.W. 2020. Reducing greenhouse gas emissions and grain arsenic and lead levels without compromising yield in organically produced rice. Agriculture, Ecosystems and Environment, 295(January), 106922. https://doi.org/10.1016/j.agee.2020.106922

Kabir, M.J., Gaydon, D.S., Cramb, R., and Roth, C. 2017. 'Bioeconomic evaluation ofcropping systems for saline coastal Bangladesh: I. Simulation under historical andfuture environments', Submitted and in-review with Agricultural Systems.

Mackill, D.J., Ismail, A.M., Pamplona, A.M., Sanchez, D.L., Carandang, J.J. and Septiningsih, E.M. 2010. Stress tolerant rice varieties for adaptation to a changing climate. Crop Environ. Bioinforma. 7: 250–259.

Mainuddin, M. and Kirby, M. 2015. National food security of Bangladesh to 2050. Food Security. 7.

Mottaleb, K.A. and Mishra, A.K. 2016. Rice consumption and grain-type preference by household: a Bangladesh case. J. Agric. Appl. Econ. 48: 298–319,

Papademetriou, M.K. 2000. Rice Production in the Asia-Pacific Region: Issues and Perspectives. In: Papademetriou MK, Dent FJ, Herath EM (eds). Bridging the Rice Yield Gap in the Asia-Pacific Region, RAP Publication, Food and Agriculture Organization of the United Nations, Regional Office for Asia and the Pacific, Bangkok. pp.58–68.

Timsina, J., Wolf, J., Guilpart, N., van Bussel L.G.J., Grassini, P. and van Wart, J. 2018. Can Bangladesh produce enough cereals to meet future demand? Agric. Sys.; 163: 36-44. pmid: 29861535

United Nations (UN) 2014. The world population prospects, Key findings andadvance tables. Department of Economics and Social Affairs, Population division, New York, USA.

Wassmann, R., Jagadish, S.V.K., Sumfleth, K., Pathak, H., Howell, G., Ismail, A., Serraj, R., Redona, E., Singh, R.K. and Heuer, S. 2009. Regional vulnerability of climate change impacts on Asian rice production and scope for adaptation. Adv. Agron. 102: 91–133.

Zeigler, R.S. and Barclay, A. 2008. The relevance of rice. Rice. 1(1): 3–10.

Zhao, M., Lin, Y. and Chen, H. 2020. Improving nutritional quality of rice for human health. Theor. Appl. Genet. 133: 1397–1413. [Google Scholar] [CrossRef] [PubMed]